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Migration, Prices and Wages in a North American Free Trade Agreement

Abstract: Much of the debate over potential wage changes under a North American Free Trade Agreement (NAFTA) reflects views about the links between output prices and factor prices as described in the Stolper–Samuelson theorem. But the Stolper–Samuelson theorem does not fully describe the likely labour market effects of NAFTA because it includes the assumption that factors do not migrate. There are two forces at work that will affect US-Mexican wages under NAFTA; (a) indirect links between prices and wages as described in the Stolper–Samuelson theorem, and (b) direct effects of migration on labour supplies in the two countries. We use an 11-sector computable general equilibrium model of Mexico and the USA with both price changes and migration to determine which wage effect dominates following trade liberalization. We find that migration effects generally dominate Stolper–Samuelson effects on wages. Empirically, Stolper–Samuelson effects are very small.

INTRODUCTION

Much of the debate over the establishment of a North American Free Trade Agreement (NAFTA) concerns its impact on wages, and the potential for NAFTA to result in higher wages for unskilled labour in Mexico, but lower wages for unskilled labour in the USA. This view can be derived from the Stolper–Samuelson theorem, which links changes in wages and rents to the changes in product prices caused by trade liberalization. Mexico is abundant in unskilled labour relative to the USA, and trade reform will increase Mexico's relative price of manufactured goods which it exports to the USA. According to the theorem, unskilled wages will fall in the USA and rise in Mexico as Mexican exports displace US production of labour-intensive goods.

But the Stolper–Samuelson theorem does not fully describe the likely labour market effects of a NAFTA for several reasons. First and foremost, is the direct effect of US-Mexico labour migration on labour supply and wages in the two countries. When using the Stolper-Samuelson theorem, aggregate factor supplies are assumed constant and shifts in labour demand curves determine wage changes. However, the effects of trade liberalization on wages can be ambiguous when there is international labour mobility which shifts the labour supply curve as well.[1]

Secondly, Mexico strongly protects agriculture, especially the food maize sector, and agriculture uses rural labour relatively intensively. The Stolper–Samuelson effects are then more complex, with trade liberalization helping manufacturing, which uses unskilled labour intensively, and hurting agriculture, which uses rural labour intensively. As Mexico eliminates barriers to food maize imports, the rural wage should fall. Given rural-urban migration within Mexico, the fall in rural wages will lead to an increase in the supply of labour to Mexican urban areas and to the manufacturing sectors. This will offset the increase in urban unskilled wages as the manufacturing sectors expand. There will also be

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an increase in migration pressure to the USA. The net wage changes in both the USA and Mexico will thus depend on a mix of Stolper–Samuelson and migration effects, and these can have offsetting effects on wages.

Finally, there are many existing distortions in both countries which will not be eliminated by NAFTA. For example, NAFTA does not affect trade barriers that Mexico and the USA maintain against other countries. In addition, there are other distortions, including existing taxes, subsidies and intersectoral differences in wages and profit rates. All these complicate trade theory, requiring analysis of trade liberalization in a 'second best' environment.

In this paper, a computable general equilibrium (CGE) model of the USA and Mexico is used which allows for both Stolper–Samuelson and migration effects to assess the wage changes that will accompany NAFTA. When specifying migration, it is assumed that workers migrate between rural and urban areas in Mexico, as well as to the rural and urban labour markets in the USA, to maintain constant real wage differences. In addition to migration, the empirical model captures other aspects of the US and Mexican economies that violate the assumptions used to analyse the links between output prices and factor prices in neoclassical trade theory. A number of existing distortions, such as indirect taxes and sectoral wage differentials, are incorporated in the model. It is also assumed that Mexico and the USA have different production technologies in the use of both intermediate inputs and primary factors.

The remainder of the paper is organized as follows. A three-country, eleven-sector, computable general equilibrium (CGE) model is described. Since most of the migration anticipated under NAFTA will come from rural Mexico, farm sectors are modelled in detail, giving attention to the rural and unskilled labour markets, and to the structure of agricultural programs.

Model simulations are presented which are designed to explore the two mechanisms, price changes and migration, through which trade reform leads to wage changes; in particular, we ask whether migration has a bigger impact on relative wages than do changes in relative output prices, the driving mechanism in the Stolper–Samuelson theorem. It is found that migration generally has the dominant effect on wages under NAFTA.

THREE-COUNTRY CGE MODEL

The CGE model is an eleven-sector, three-country, computable general equilibrium model. The production and consumption behaviour in the USA and Mexico is modelled in detail, and the two countries are linked through trade and migration flows. Production and consumption details are not specified for the rest of the world. Rather, world demand and supply functions for traded goods are specified[2] largely by assuming fixed world prices. The model's 11 sectors include four farm and one food processing sector. The food maize sector refers to maize used for human consumption. The program crops sector is composed of the other crops eligible for US deficiency payments — feed maize, food grains, soybeans and cotton. Other agriculture includes livestock, poultry, forestry and fisheries, and other miscellaneous agriculture.[3]

The model is in the theoretical tradition of neoclassical, trade-focused, CGE models. Each sector produces a composite commodity that can be transformed according to a

constant elasticity of transformation (CET) function into a commodity sold on the domestic market or into an export. Output is produced according to a constant elasticity of substitution (CES) production function in primary factors, and fixed input-output coefficients for intermediate inputs.

The model simulates a market economy, with prices and quantities assumed to adjust to clear markets. All transactions in the circular flow of income are captured. Each country model traces the flow of income (starting with factor payments) from producers to households, government, and investors, and finally back to demand for goods in product markets. Consumption, intermediate demand, government, and investment are the four components of domestic demand. There are three key macro balances in each country model, the government deficit, aggregate investment and savings, and the balance of trade.

The model includes six primary factors: rural labour, urban unskilled labour, urban skilled labour; professional labour, capital and agricultural land. Full employment for all labour categories is assumed and aggregate supplies are set exogenously. In the experiments reported here, it is assumed that agricultural land is immobile among crops, but that all other factors are intersectorally mobile.

Agricultural trade policies and domestic farm programs are modeled explicitly, including tariffs, import quotas, input subsidies to producers and processors, Mexico's tortilla subsidies to low income households, and the US deficiency payment program. Deficiency payments and the tariff-equivalents of quotas are determined endogenously and are not treated as fixed *ad valorem* wedges.

In the CGE model, three migration flows are specified: rural Mexico to rural US labour markets, urban unskilled Mexico to urban unskilled US labour markets, and internal migration within Mexico from rural to unskilled urban labour markets.[4] In equilibrium, international migration adjusts to maintain a specified ratio of real average wages, for linked labour markets in the two countries, measured in a common currency. Similarly, internal migration in Mexico maintains a specified ratio of average real wages between the rural and unskilled urban markets. The domestic labour supply in each skill category in each country is adjusted by the migrant labour flow.

Migration flows generated by the CGE model refer to changes in migration from a base of zero. They should be seen as additional migration flows due to the policy change, adding to (or reducing) current flows.

To determine migration levels, one must evaluate the labour market equilibrium in each country as well as the migration equation. The system of labour demand and labour supply equations by country, including migration between countries, is solved simultaneously. Labour demand in each country is a function of the output price and the relative wage. The vertical labour supply curve shifts when labour migrates.

To identify sources of the wage change in a simple general equilibrium model with migration, one can consider the forces affecting labour supply and demand independently. Labour demand shifts depend on changes in the relative output price given factor intensities in production. For example, an increase in the output of the labour intensive good means that labour demand will increase. The magnitude of the labour demand shift depends on the output elasticity to a relative price change and on the elasticity of labour demand to an output change. Given a fixed aggregate labour supply, the wage will increase following an increase in the price of the labour intensive good.

When one allows labour to migrate, and assumes workers migrate to maintain fixed wage differentials, labour moves into the country that experiences the wage increase under

no migration. The increase in labour supply reduces the wage. Since the supply curve shifts, the wage elasticity of labour demand matters in determining wage changes in the home country. Migration occurs until the initial wage differential has been re-established. When the labour demand curve is inelastic, a small amount of migration is needed to affect wages and restore the initial differential. More migration occurs when the labour demand curves in each country are more elastic. In an empirical model, the magnitude of the labour demand and labour supply changes will depend on the elasticities implicit in the observed base-year equilibrium.

MODEL RESULTS

Three scenarios are specified which are designed to explore wage and migration changes that accompany bilateral tariff and quota elimination between the USA and Mexico. In the scenarios, alternative assumptions are made about labour migration to decompose the effects of relative price changes and migration on wages. Scenario 1, considers bilateral trade liberalization between the USA and Mexico when there are no migration flows.

Table 1 *Real Factor Returns Under a USA-Mexico FTA, With and Without Migration*

	No migration	Internal migration	Internal and international migration
Migration		— '000 persons —	
US rural	0	0	20
US urban unskilled	0	0	400
Mexican rural-urban	0	180	340
US factor prices		–Percent change from base–	
Rural	0.8	0.9	–1.0
Urban unskilled	–0.1	–0.1	–1.0
Union	0.0	0.0	0.1
Professional	0.0	0.0	0.0
Agricultural land	0.5	0.5	0.7
Capital	–0.1	–0.1	0.0
Mexican factor prices			
Rural	–5.3	–1.9	1.0
Urban unskilled	0.4	–1.9	1.0
Union	0.6	0.6	0.4
Professional	0.5	0.5	0.3
Agricultural land	–6.6	–6.7	–7.6
Capital	0.2	0.3	0.2

To evaluate internal migration effects, Scenario 1 is extended and migration within Mexico between its rural and urban unskilled labour markets is allowed in Scenario 2. Finally, in Scenario 3 both internal Mexican migration and international migration flows between the rural and urban unskilled labour markets in Mexico and the USA are allowed, in conjunction with bilateral trade liberalization. In the scenario with full migration, the

sensitivity of migration to different model assumptions is considered, focusing on the role of exchange rates and fixed wage differentials. In all three scenarios, no change in domestic policies is assumed.

With no migration, trade liberalization causes Mexico's rural wage to decline over 5 percent, while the US rural wage rises 0.8 percent, consistent with the Stolper–Samuelson theorem (Table 1). Increasing the mobility of rural labour diminishes the effects of falling Mexican farm prices on rural wages. When it is assumed labour can migrate between rural and urban areas in Mexico, Mexican rural wages decline by only 2 percent. As 180 000 workers migrate to urban areas, the decline in the rural labour supply partially offsets the effect of a decline in labour demand on the rural wage.

In Mexico's urban labour market, unskilled wages rise 0.4 percent when there is no migration, reflecting the increase in the demand for labour as the manufacturing sectors expand. With internal migration, the migration effect dominates the labour demand effect on wages. The increase in labour supply due to urban migration causes urban unskilled wages in Mexico to decline by 2 percent, despite the increase in labour demand as output expands under NAFTA.

Table 2 *Aggregate Effects of a USA-Mexico FTA, With and Without Migration*

	Scenario 1 No migration	Scenario 2 Internal migration	Scenario 3 Internal and international migration
		— Percent change from base —	
Real GDP – USA	0.0	0.0	0.1
Real GDP – Mexico	0.5	0.6	0.3
Exchange rate – USA	0.0	0.0	0.0
Exchange rate – Mexico	2.1	2.2	2.0
US exports to Mexico	8.4	8.7	8.6
US exports to rest	0.0	0.0	0.2
US imports from rest	0.1	0.1	0.2
Mexican exports to USA	5.0	5.0	5.1
Mexican exports to rest	4.7	5.0	4.6
Mexican imports from rest	–0.6	-0.6	–0.8
Farm program expenditure:			
USA	–0.7	–0.7	–0.5
Mexico	–1.5	–1.9	–2.6
Terms of trade:		— Index, base = 1.0 —	
USA to Mexico	1.01	1.01	1.01
USA to world	1.00	1.00	1.00
Mexico to USA	0.99	0.99	0.99
Mexico to world	0.99	0.99	0.99

Notes: The 'real exchange rate' is the price-level-deflated exchange rate using the GDP deflator. A positive change represents a depreciation. Exports are valued at world prices (in dollars).

In Scenario 3, it is found that international migration reverses the effects of NAFTA on rural wages in the USA and Mexico, compared to the scenario with no migration. When is international migration is assumed, 360 000 rural Mexican workers (6 percent of the farm labour force) migrate to either urban Mexico or to the USA. This decline in the supply of

rural workers causes Mexican rural wages to rise by 1.0 percent, dominating the agricultural price decline which works to reduce farm wages. In the USA, the increase in rural labour supply causes rural wages to fall by 1.0 percent, despite the upward pressure of rising farm prices on rural wages.

With international migration, the changes in the labour supply in Mexico's urban labour market depend on the net effect of labour entering from the rural areas and labour leaving for the US urban areas. Under NAFTA, migration to the USA dominates and the Mexican urban labour supply declines. The decrease in labour supply and the increase in labour demand associated with output changes following NAFTA complement one another in terms of the effect on the urban wage in Mexico. The Mexican urban wage increases 1 percent, compared to an increase of 0.4 percent when only labour demand changes affect the wage in Scenario 1.

In the USA, the urban wage declines further with international migration than in scenario 1, with no migration. With no migration, the decline in the demand for urban unskilled labour (following the price changes associated with NAFTA) reduces the urban unskilled wage by 0.1 percent. This Stolper–Samuelson effect is quite small. The increase in the supply of urban unskilled labour, in the scenario with migration, reduces the urban unskilled wage further. It declines by 1.0 percent in the USA — still small, but an order of magnitude larger than the Stolper–Samuelson effect.

In Mexico's urban labour market, unskilled wages rise 0.4 percent when there is no migration, reflecting the increase in the demand for labour as the manufacturing sectors expand. With internal migration, the migration effect dominates the labour demand effect on wages. The increase in labour supply due to urban migration causes urban unskilled wages in Mexico to decline by 2 percent, despite the increase in labour demand as output expands under NAFTA.

Aggregate effects of NAFTA are reported in Table 2. Unlike the case of factor prices, aggregate results of NAFTA are almost unchanged by varying the migration assumptions in Scenarios 1–3. For the USA, there are no measurable aggregate efficiency gains from trade liberalization with Mexico in Scenarios 1 and 2, and migration largely accounts for the small increase in GDP in Scenario 3. In Mexico, real GDP increases slightly in all scenarios, but is lowest in Scenario 3, because labour migration to the USA reduces its labour endowment.

Bilateral trade increases significantly in all three NAFTA scenarios. For the USA, NAFTA is trade creating in all three scenarios, with imports rising from both Mexico and the rest of the world. For Mexico, NAFTA causes some trade diversion.

Both countries' farm program expenditures fall under all three scenarios. In the USA, the decline in expenditure reflects a decline in the deficiency payment because farm prices rise with export growth to Mexico. In Mexico, farm program expenditures fall because of the decline in farm output. Bilateral trade expansion occurs with virtually no effect on the international terms of trade. Sectoral results are presented in Table 3. Bilateral export growth of both countries under NAFTA is highest in the farm sectors, reflecting that both countries have provided relatively high trade protection to agriculture. Agricultural trade growth is accomplished mostly through changes in crop mix, with little change in total farm output.[5]

Table 3 *Sectoral Effects of an FTA on the USA and Mexico, With and Without Migration*

	No migration		Internal migration		Internal and international migration	
	Output	Exports	Output	Exports	Output	Exports
United States			— percent change from base —			
Farm	0.2	44.5	0.2	47.9	0.4	51.3
Maize	4.9	128.4	5.2	134.9	6.7	141.8
Program crops	0.3	36.8	0.3	41.0	0.7	44.0
Fruit/vegetables	0.1	13.3	0.1	13.1	0.4	11.9
Other agriculture	0.1	8.9	0.1	9.3	0.2	8.8
Food processing	–0.1	8.7	–0.1	9.0	0.1	8.5
Other light mfg.	0.0	7.4	0.0	7.6	0.1	7.1
Oil/gas	0.0	17.8	0.0	18.0	0.0	17.7
Intermediates	0.1	8.4	0.1	8.4	0.2	8.0
Consumer durables	0.0	9.5	0.0	9.5	0.2	9.3
Capital goods	0.1	9.5	0.1	9.5	0.1	9.2
Services	0.0	–2.4	0.0	–2.4	0.1	–2.6
Mexico						
Farm	0.1	10.2	–0.3	9.4	–1.1	8.8
Maize	–8.8	0.0	–10.8	0.0	–13.1	0.0
Program crops	–3.7	0.0	–4.5	0.0	–5.5	0.0
Fruit/vegetables	7.7	21.7	6.5	21.2	5.2	21.1
Other agriculture	0.6	2.2	0.5	2.0	0.0	2.0
Food processing	0.1	7.7	0.0	7.6	–0.5	7.7
Other light mfg.	0.7	8.8	0.8	8.9	0.6	9.0
Oil/gas	0.0	4.3	0.0	4.3	0.0	4.5
Intermediates	1.5	4.0	1.6	4.1	1.4	4.2
Consumer durables	4.3	5.5	4.7	5.8	4.7	5.8
Capital goods	2.8	7.7	2.9	7.8	2.8	7.7
Services	–0.2	0.1	-0.1	0.2	–0.3	0.2

Note: Real output and exports. Exports are to partner country (USA or Mexico).

CONCLUSION

Much of the debate over potential wage changes under NAFTA reflects views about the indirect links between output prices and factor prices as described in the Stolper–Samuelson theorem. The model underlying the theorem assumes no international factor mobility, which is unrealistic for the USA and Mexico, where there is significant labour migration. An eleven-sector CGE model of the USA and Mexico is developed that includes both relative-price and migration effects, to analyse the empirical importance of the two mechanisms. It is found that Stolper–Samuelson effects occur, but that they are very small, and have perhaps been given too much emphasis in the debate over the wage effects of NAFTA. Furthermore, migration effects largely dominate indirect price effects,

generating wage changes under NAFTA that are contrary to expectations based on the Stolper–Samuelson theorem alone.

In the farm sector, for example, when we assume no migration, we find that removing protection causes rural wages in Mexico to fall (and rural wages in the USA to rise), reflecting Mexico's current high levels of protection to agricultural sectors. These results are consistent with the Stolper–Samuelson theorem. When migration is allowed, the wage effects are reversed. The decline in the rural labour supply in Mexico causes the rural wage to rise rather than fall. Conversely, in the USA, the rural wage falls, due to the increased rural labour migration from Mexico.

NOTES

[1] In the Heckscher–Ohlin model, trade in factors can be a substitute for trade in commodities. Both can have an identical effect on wages under certain assumptions such as unrestricted factor flows and incomplete specialization under free trade. The issue becomes more complex in US-Mexico relations because technologies are very different and there are migration restrictions. One does not necessarily expect migration to have the same effect on wages as the labour demand changes described in the Stolper–Samuelson theorem.

[2] In two sectors, maize and program crops, downward sloping world demand curves for US exports are assumed, and hence world prices are not fixed for these sectors.

[3] The base year for Mexico is mostly 1988. The USA uses a 1987 base year because of the severe contraction of agricultural output following the 1988 drought. Bilateral trade flows are from 1988. Because of the volatility in USA 1987–88 agricultural output, the model follows Adams and Higgs (1986) in the use of a 'synthetic' base year for the USA, imposing 1988 US-Mexican bilateral trade flows on a 1987 base USA economy. The data base is documented in Burfisher, Thierfelder, and Hanson (1992). Unpublished data on Mexican employment were compiled by Dolores Nieto, Colegio de Mexico.

[4] There is no internal migration between the urban and the rural labour market in the USA, but the two labour markets are implicitly linked, given the other migration flows.

[5] Since migration effects largely determine the wage changes following NAFTA, we do sensitivity experiments of our specification of migration against Scenario 3. First, we eliminate the exchange rate effects on the migration decision by fixing the exchange rate in the migration equation at the base year level. We find that migration from Mexico to the USA falls compared to Scenario 3, in which the depreciating Mexican peso stimulates migration. In Mexico's rural labour market, migration effects no longer dominate the effects of relative price changes on the rural wage. In Mexico's urban unskilled labor market, and in the US labour markets, migration effects on wages still dominate, but have less of an impact. Second, we explore the sensitivity of migration to our assumption that wage differentials between the USA and Mexico are held constant at their base year levels. We find that the results are sensitive to this assumption. If Mexico grows more rapidly than the USA, the model will generate a large decrease in migration in order to maintain the wage differential. Over the long run, with increased Mexican growth, one expects to observe growth in wages, a narrowing of the wage differential between the two countries, and a reduction in migration pressure. We have not sought to capture this mix of effects in the model because these long-run trends are not directly related to NAFTA. Finally, three key elasticities affect the magnitude of migration: output elasticity to a relative price change, labour demand elasticity with respect to output change, and the wage elasticity of labour demand. While we do not do sensitivity tests around elasticities, we can define and evaluate the values implicit in our data on the US and Mexican economies. The differences in elasticities help to explain the patterns of migration changes we observe in the empirical model.

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